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ENERGY CONSUMPTION GUIDE 70

Energy use in the minerals industries of Great Britain

"Whether you are a small single-site operator or one of the major multi-site companies, any opportunity to save money must be grasped with both hands.

This Guide contains advice which, if followed, will allow you to save money easily by looking in detail at your production energy use and taking steps to minimise it."

Simon van der Byl
Director-General,
Quarry Products Association

QUARRY PRODUCTS ASSOCIATION

BEST PRACTICE PROGRAMME
ENERGY EFFICIENCY

BEST PRACTICE PROGRAMME

ENERGY COMSUMPTION GUIDE 70

ABOUT THIS GUIDE

ARE YOU USING TOO MUCH ENERGY?

You can easily calculate your energy use, but how much energy should you be using? Unless you know how other operators in your sector are performing, this is impossible to gauge. This Guide provides you with the information you need to help you make that comparison.

It shows you how to compare your data with others in the sector, based on the findings of a recent survey into the minerals industries of Great Britain.* It contains detailed instructions on how to calculate and summarise your own site energy consumption using a simple energy use calculator. This can be compared with the data supplied by other operators in your sector.

The information is split into sectors representing the main divisions within the industry:

- Crushed rock
  - igneous and metamorphic;
  - limestone (including dolomite);
  - sandstone.
- Sand and gravel.
- Common and construction sand.
- Ready-mixed concrete.
- Burnt lime.
- Bituminous products.

Throughout this Guide, a useful measure of energy used is the specific energy consumption (SEC). This is defined as kilowatt hours consumed per tonne of material extracted or produced (kWh/tonne).

Details of actions taken by some of the best performers in each sector are described, together with advice on simple measures that you can put in place to help cut your energy bills. On the back cover there is a list of free publications covering energy saving techniques relevant to the minerals industry.

WHO SHOULD READ THIS GUIDE?

This Guide will be of interest and use, not only to managers at the sharp end, the quarry and plant staff, but also to the energy and senior production staff at Head Office.

The measures recommended can be just as effective for a single site as when applied across the whole of a company's operations.

THE SURVEY

In 1996, the Energy Efficiency Best Practice Programme commissioned a survey of energy use in all sectors of the mineral extraction and mineral products industries of Great Britain.* The trade associations, BACMI and SAGA (now amalgamated as the Quarry Products Association) provided invaluable encouragement, emphasised by the high level of quality responses.

Using a confidential, non-attributable questionnaire, data were collected on process energy consumption, the types and proportions of fuels used, and fuel costs. Some operators were able to split their data and identify consumption for specific activities, while others had access only to a whole-site figure.

This survey was conducted on behalf of the Energy Efficiency Best Practice Programme by:
Carraig Associates. Tel/Fax: 01463 782320.

* The minerals industries of Northern Ireland have already been surveyed and the results are presented in Energy Consumption Guide 47, *The minerals industries of Northern Ireland*, available free from the address on the back page of this Guide.

THE RESULTS

THE RESULTS

A total of 429 replies were received, representing an average site response rate of 27% for the industry. The response rates, in terms of production volume for sectors providing sufficient detailed information, were as follows:

- Crushed rock
  - igneous 41.5%;
  - limestone 44.8%;
  - sandstone 17.6%.
- Sand and gravel 31.1%.
- Common and construction sand 91.1%.
- Burnt lime 40.0%.
- Bituminous products 35.1%.

The response level was sufficient to be confident that the average figures calculated from the data are representative of the whole sector.

THE INDUSTRY

The industry sectors covered in this Guide use a total of 10.7 million MWh (1 MWh = 1,000 kWh) at a cost of about £150 million. Table 1 shows the estimated total annual energy use and production figures for each sector. These were obtained by extrapolation from the data provided in the survey.

USING THE RESULTS

The Guide presents the results for each sector and sub-sector, highlighting significant features. Data are presented on charts as follows:

- SEC is plotted on bar charts to highlight the range of SEC across sites of similar operations. The charts show that while there is a reasonable spread of SECs about a mean there is often a 'tail' of high energy users. If your site falls here (and there is no unique reason for the figure to be high, such as steep or long haul roads, or extremely hard rock), then there is clearly much room for improvement and this Guide will show you what to do.

However, do not be complacent if your SEC is lower - every site can do better, even those that are already below the industry mean.

- Line charts are used to plot energy use against production (i.e. the SEC) - a solid red line shows 'best fit' through the data. Use this as a guideline for comparison with your own consumption. Then set yourself targets. The dotted green line represents a reduction of 20% in energy use from the guideline.

For some sectors two graphs are presented to allow for the very wide spread of size of operation. In these cases there are no individual points for the larger sites as there are fewer of them and confidentiality must be preserved.

- Pie charts are used to highlight the proportions of types of energy used in each sector, together with a comparison of costs.*

* Not all respondents provided cost data, but, from those that did, the average figures were: electricity 5.5 p/kWh; natural gas 0.5 p/kWh; gas oil 1.1 p/kWh; reclaimed oil 0.7 p/kWh.

Table 1 Estimated annual energy use in the minerals industries of Great Britain

Sector	Estimated total annual energy bill (£million/yr)	Total production 1995 (million tonnes)	Total annual energy use (MWh/yr)	Average SEC* (kWh/t)
Crushed rock				
igneous	15.3	49.5	763,000	15.4
limestone	23.3	106.0	1,106,000	10.4
sandstone	3.7	14.7	169,000	11.5
Sand and gravel	23.5	94.0	943,000	10.0
Common and construction sand	0.4	2.8	24,000	8.3
Ready-mixed concrete	8.0	40.0	144,000	3.6
Burnt lime	19.2	2.5	3,751,000	1,500.4
Bituminous products	59.3	34.9	3,776,000	108.2

* The average SEC is a simple average obtained by totalling the SECs for each operation in a sector and dividing by the number of operations used. It is calculated this way (rather than by summing energy usage and dividing by summed tonnages) to avoid the skewing effect that a large site would have over several small sites.

CRUSHED ROCK - IGNEOUS/METAMORPHIC

CRUSHED ROCK

The crushed rock sector produced 170 million tonnes in 1995 from over 450 operating quarries. Most of the material was used as aggregate. The sector is normally divided into three groups defined by rock type. This split, together with annual production figures and numbers of sites, is shown in Table 2.

Table 2 identifies that the igneous and limestone groups are by far the largest in terms of production. Production at sites in these two sub-sectors varies, mostly between 50,000 - 1,000,000 tonnes/year, with a small number of much larger multi-million-tonne sites. Sites producing sandstone are generally smaller, producing under 450,000 tonnes/year.

In 1995 the total delivered energy use for the whole sector was estimated to be 2 million MWh, at a cost of approximately £40 million.

Igneous/Metamorphic

In Great Britain about two-thirds of the sites in this sub-sector work either coarse-grained acid igneous rocks (generally referred to as granites) or fine to medium-grained basic igneous rocks (generally termed basalts and dolerites respectively). Useable data were collected from 12 (of 35) granite quarries and 17 (of 68) basalt/dolerite operations.

Fig 1 shows the range of SECs in the sector and Figs 2 and 3 show how energy consumption varies with production level.

Within the basalt/dolerite group there were many sites with SECs higher than those for granite sites. This situation could be explained on geological grounds; the finer-grained, more dense rocks have greater structural integrity and require much more rock breaking effort, both initially and in the crushing plant. However, statistically the results overlap and it is therefore appropriate for the two groups to be regarded as a single sub-sector.

Table 2 Annual production in the crushed rock sector (1995)

Rock type	Production (million tonnes)	Number of sites
Igneous (including metamorphic)	49.5	169
Limestone (including dolomite)	106.0	222
Sandstone	14.7	66

Photograph courtesy of Quarry Management

CRUSHED ROCK - IGNEOUS/METAMORPHIC

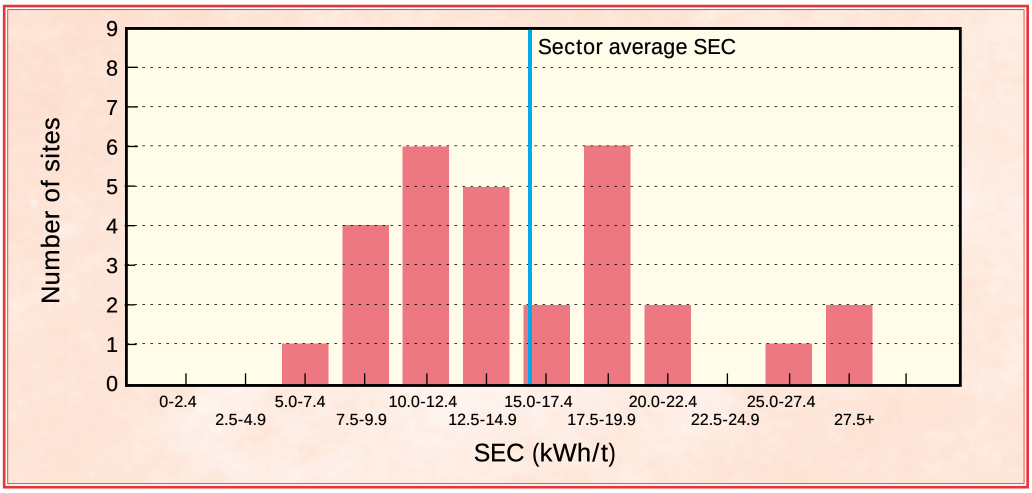


Fig 1 Range of SECs in the igneous/metamorphic rock sub-sector

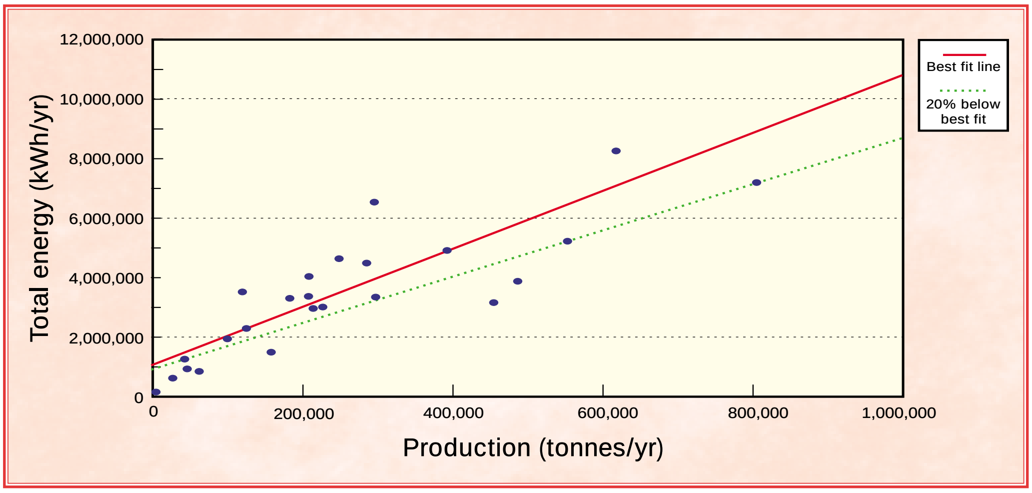


Fig 2 Annual energy consumption in the igneous/metamorphic rock sub-sector (site production 0 - 1,000,000 tonnes)

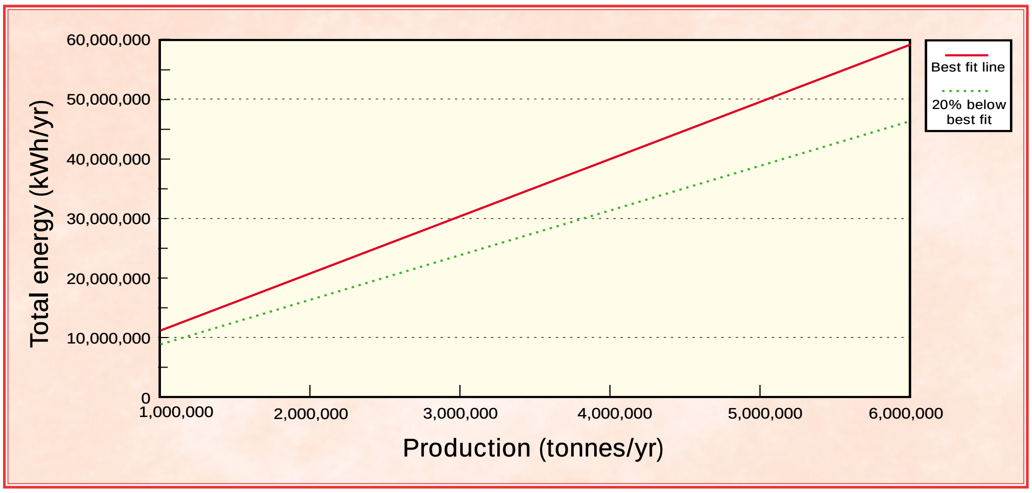


Fig 3 Annual energy consumption in the igneous/metamorphic rock sub-sector (site production 1,000,000 - 6,000,000 tonnes)

CRUSHED ROCK - LIMESTONE

Limestone

The two main limestones for crushed rock purposes are the carboniferous limestones of the Mendips, Pennines and North and South Wales, and the dolomitic (calcium/magnesium) limestones occurring mainly to the east of the Pennines from Nottingham to north-east England. Both are hard, competent rocks and because the limestone type was identified in only a few cases, it was considered reasonable to present all the data together.

Fig 4 shows the range of SECs in the sector and Figs 5 and 6 show how the energy consumption varies with production level.

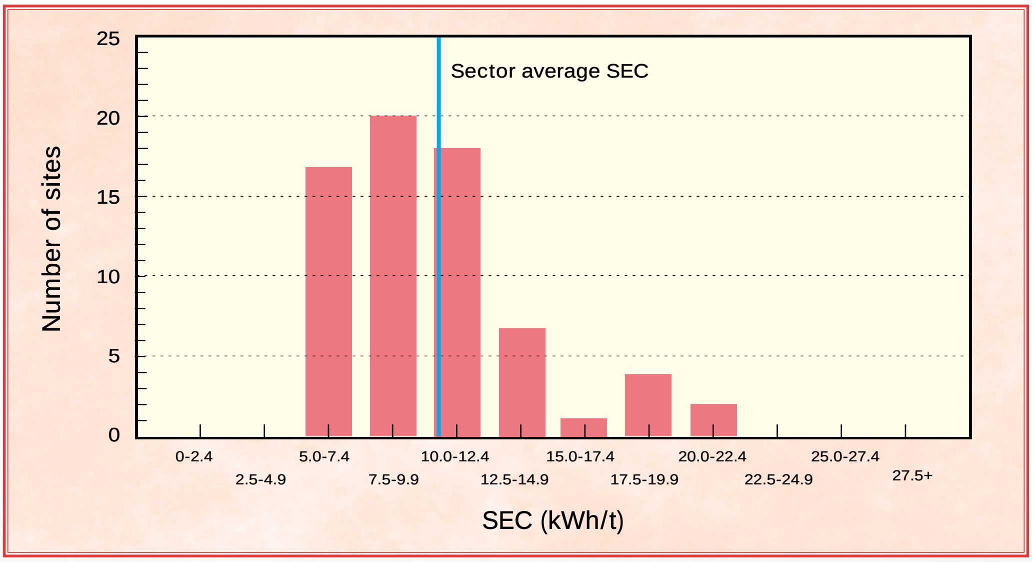
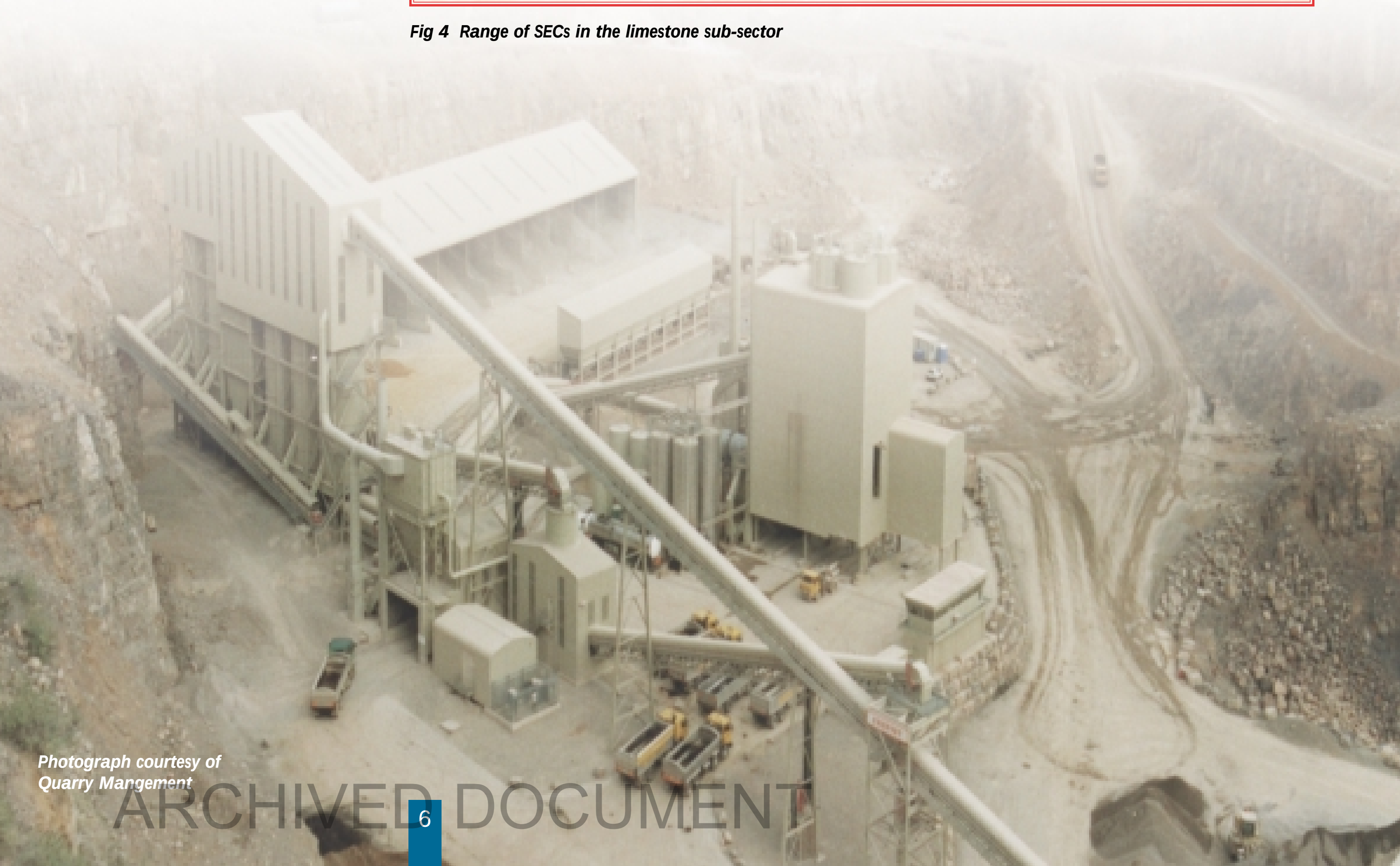


Fig 4 Range of SECs in the limestone sub-sector



Photograph courtesy of Quarry Management

CRUSHED ROCK - LIMESTONE

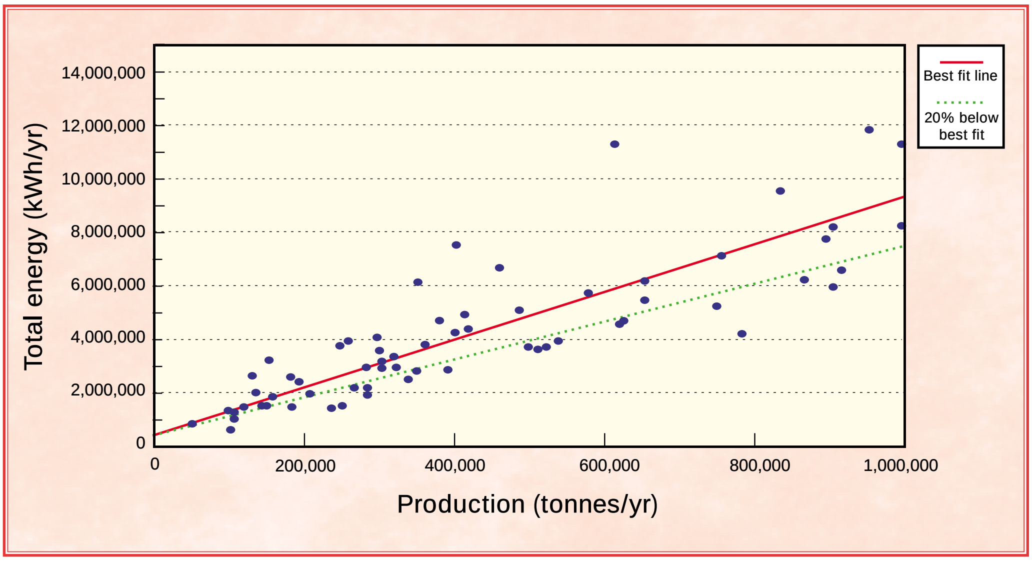


Fig 5 Annual energy consumption in the limestone sub-sector (site production 0 - 1,000,000 tonnes)

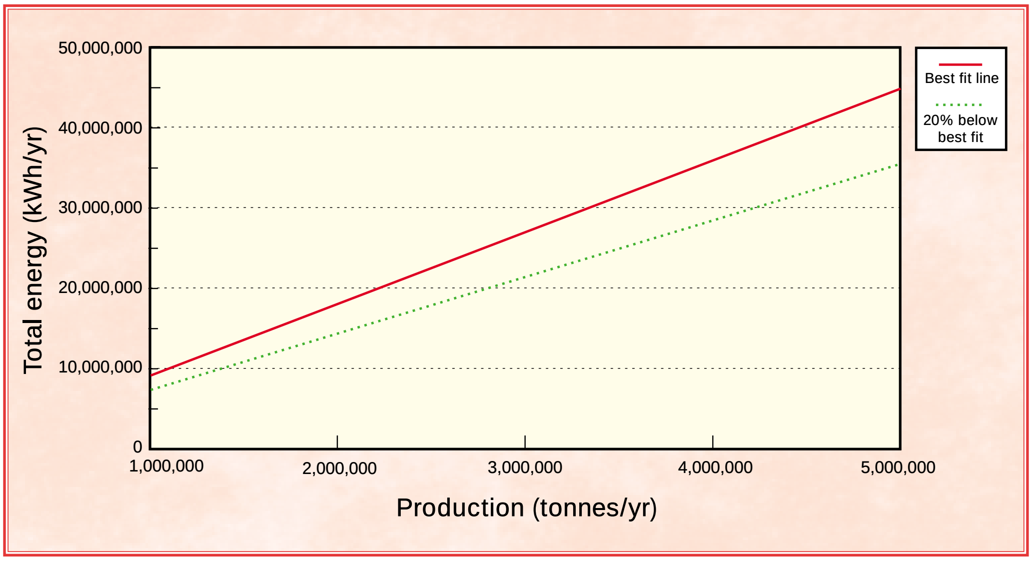


Fig 6 Annual energy consumption in the limestone sub-sector (site production 1,000,000 - 5,000,000 tonnes)

CRUSHED ROCK - SANDSTONE

Sandstone

The millstone grit of the Pennines is the main source of sandstone though there is a contribution from other hard, impure sandstones, particularly from the Welsh Borders.

Fig 7 shows the range of SECs in the sector and Fig 8 shows how energy consumption varies with production level. The individual data points are hidden to preserve confidentiality.

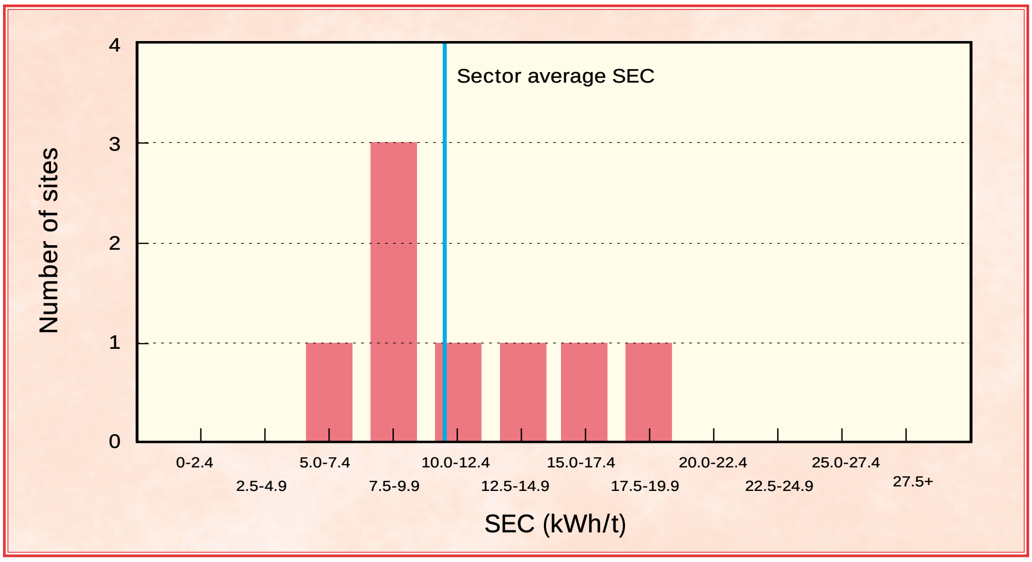


Fig 7 Range of SECs in the sandstone sub-sector

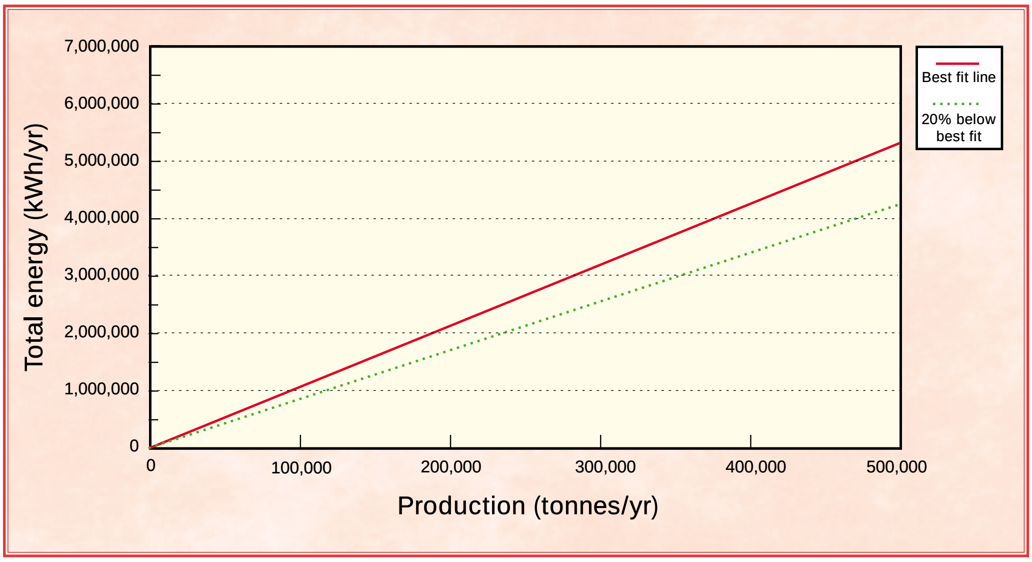


Fig 8 Annual energy consumption in the sandstone sub-sector

CRUSHED ROCK - DATA ANALYSIS

DATA ANALYSIS

The bar charts, Figs 1, 4 and 7, show the variation in site SEC for each crushed rock sub-sector. For both the igneous and limestone sub-sectors there is a reasonable spread about the mean but each shows a tail of relatively high energy users. The chart for sandstone is not as conclusive due to the low number of sites.

Figs 2 and 3 (igneous rock); Figs 5 and 6 (limestone); and Fig 8 (sandstone) are the SEC graphs for each sub-sector. In Figs 2 and 5, which show individual site performance, most of the larger plants are plotted 'below the line' demonstrating economies of scale. This highlights an important point - larger sites should expect to have lower SECs than smaller ones. A few sites plot significantly above the line - these have great scope for cost savings. One site on Fig 5 is nearly twice the best fit line and is thus spending about £120,000/year more on energy than a similar-sized site which has an SEC near the line.

Table 1 (page 3) shows that the average SECs vary significantly between sub-sectors. As the main activities in the production of crushed rock are similar throughout the sector, it is likely that the differences reflect the differing hardness and texture of the rock types.

The common activities may be summarised briefly as:

- extraction - rock breaking, loading;
- haulage - usually by mobile plant;
- processing - crushing, screening.

Extraction and haulage are usually undertaken by gas oil-powered mobile plant while the majority of processing plant is driven by mains electricity. Some smaller operations may make total or partial use of diesel-powered generation. Although the average SECs vary significantly between the sub-sectors, the pie charts (Figs 9, 10 and 11) show that the split between energy type is very similar.

For each sub-sector the dominant energy type is gas oil. However, in terms of expenditure the situation is reversed because of the relatively high cost of electricity.

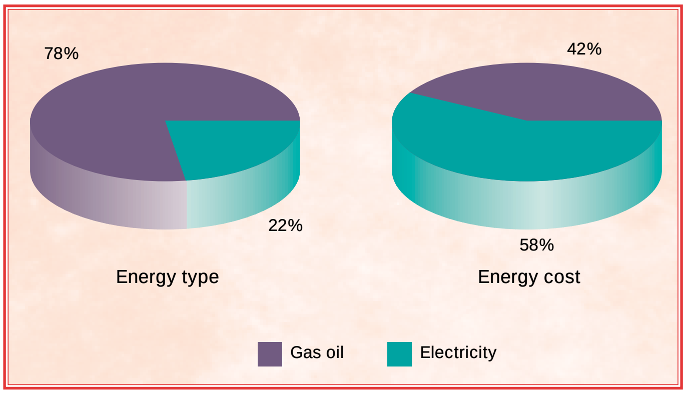


Fig 9 Energy use and cost in the igneous rock sub-sector

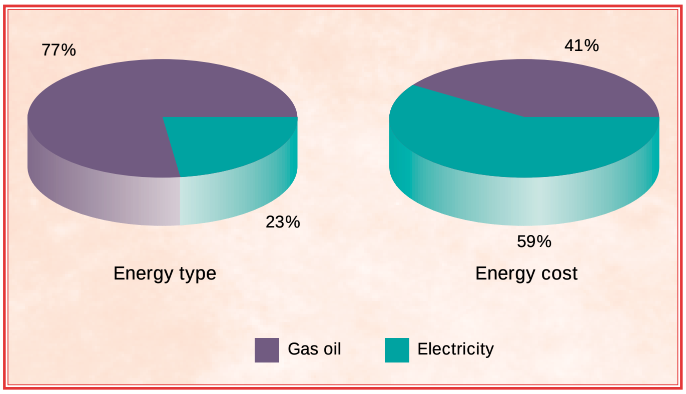


Fig 10 Energy use and cost in the limestone sub-sector

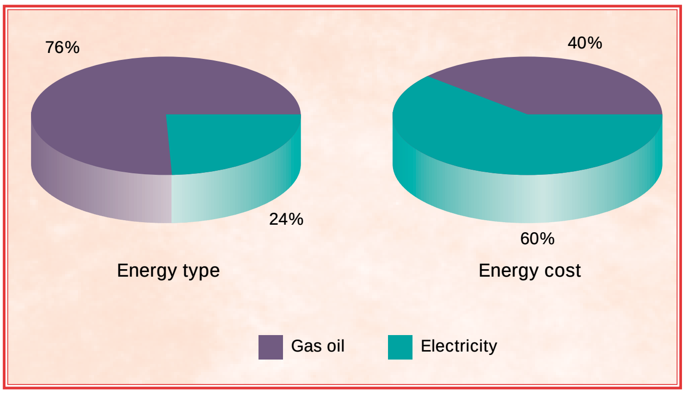


Fig 11 Energy use and cost in the sandstone sub-sector

SAND AND GRAVEL

Photograph courtesy of Quarry Management

SAND AND GRAVEL

In 1995, 94 million tonnes of land-won sand and gravel were extracted from a diverse variety of sources. These range from loose materials in the major river valleys (Thames, Trent, Severn, Clyde, Forth), to the hard Bunter pebble beds of the English Midlands which require substantial crushing. Responses were received from 143 out of 513 sites representing 31.1% of annual production. The variation in site size is large, from single operators (periodically used sites producing below 15,000 tonnes/year), to large operations approaching 1,000,000 tonnes/year. The major operators which contributed gave no indication of site locations.

Total delivered energy use for 1995 was 0.9 million MWh, costing the sector £23.5 million/year.

Fig 12 shows the variation in site SEC about the mean, with a high-use tail. Figs 13 and 14 show how energy use varies with production level in the sector. Fig 13 shows a very wide scatter of points, some of which could be explained in operational terms, for example different methods and types of haulage, degrees of processing and washing. However, it also suggests that there could be great scope for improvement in this sector.

Table 1 (page 3) indicates that the average SEC is only just lower than that for the limestone and sandstone crushed rock sub-sectors. Initially, this might seem surprising; extraction is often simpler and processing may involve only washing and screening. However, after discussion with operators, an explanation may be that the smaller plant used, both mobile and fixed, could be inherently less energy efficient and does not benefit from economies of scale.

Fig 15 shows a split between energy type similar to crushed rock and consequently a similar cost profile.

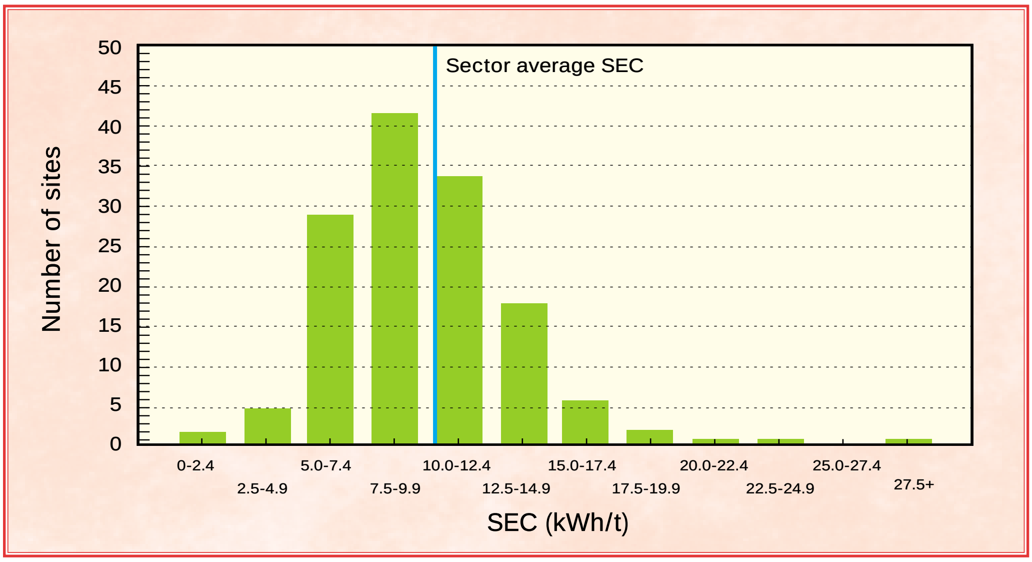


Fig 12 Range of SECs in the sand and gravel sector

SAND AND GRAVEL

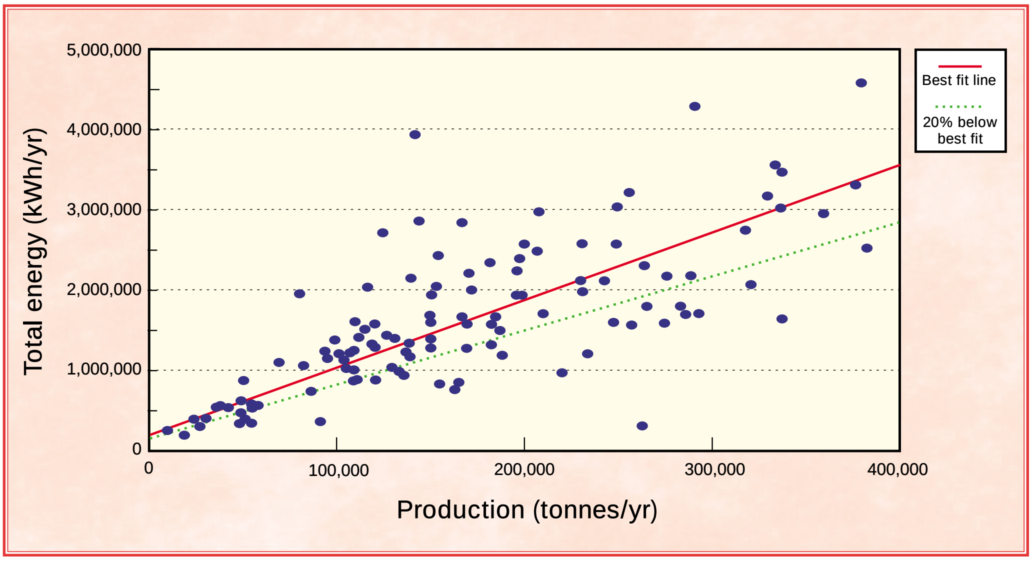


Fig 13 Annual energy consumption in the sand and gravel sector (site production 0 - 400,000 tonnes)

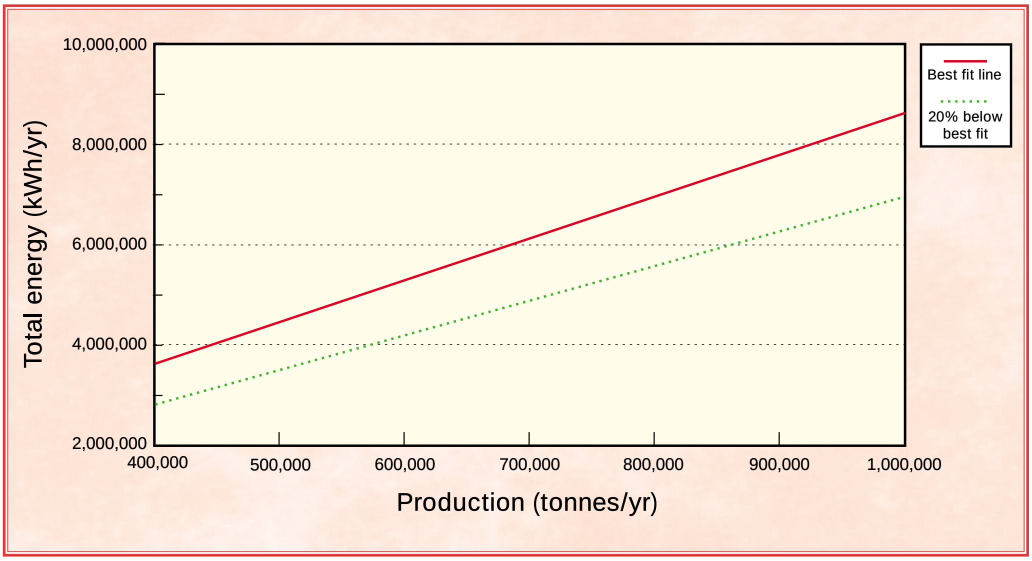


Fig 14 Annual energy consumption in the sand and gravel sector (site production 400,000 - 1,000,000 tonnes)

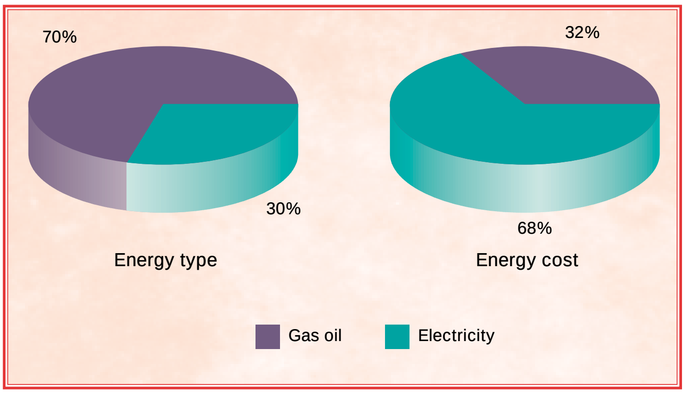


Fig 15 Energy use and cost in the sand and gravel sector

COMMON AND CONSTRUCTION SAND

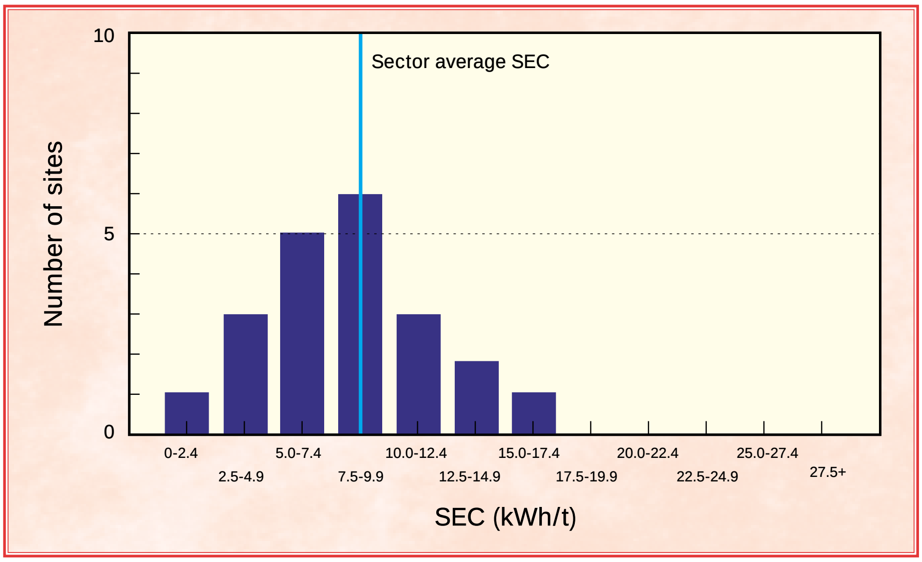


Fig 16 Range of SECs in the common and construction sand sector

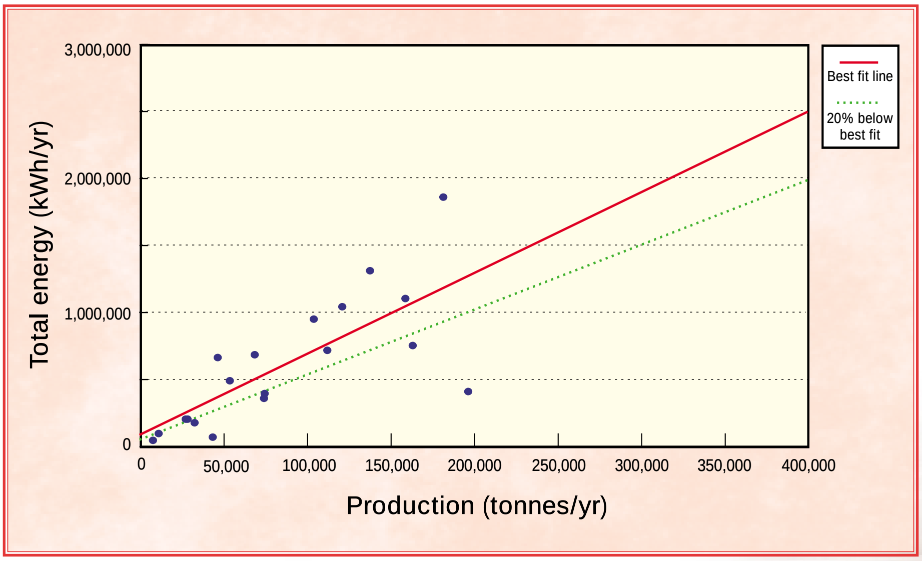


Fig 17 Annual energy consumption in the common and construction sand sector

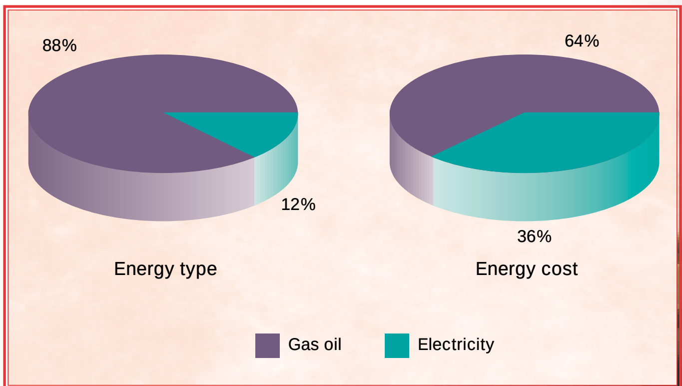


Fig 18 Energy use and cost in the common and construction sand sector

COMMON AND CONSTRUCTION SAND

This sector excludes the highly processed glass and chemical sands referred to by the industry as silica sands.

Around 2.8 million tonnes of sand are dug each year from nearly 200 sites which vary in size from operators producing a few thousand tonnes up to those producing a maximum of about 350,000 tonnes.

The total delivered energy use for the sector is comparatively low at 24,000 MWh (see Table 1, page 3), reflecting the limited degree of sophistication generally required to extract and process the product. Fig 16 indicates little evidence of a high-user tail, suggesting that, overall, the sector is quite homogeneous. To preserve confidentiality, Fig 17 omits one large site.

Fig 18 emphasises the dominance of gas oil as a fuel – primarily because the main activity is extraction and haulage by mobile plant, with little electrically-powered processing required. The cost split shows the impact of the relatively high cost of electricity.

READY-MIXED CONCRETE AND BURNT LIME

READY-MIXED CONCRETE

Concrete is formed by mixing sand, gravel and cement together. This may be carried out centrally where the mixing is undertaken wet and then loaded into road transport. Alternatively, the dry materials may be premixed prior to addition of water in the road transport itself. The major uses for ready-mixed concrete are in the building and construction industries.

During the survey, data were collected from a small sample of ready-mixed concrete operations. Energy to the sites was totally electrical and while the sector energy use is generally low there was a substantial spread of individual results and no specific trends were identifiable.

The average SEC from 15 sites was 3.6 kWh/tonne with a range of 1.2 - 7.7 kWh/tonne.

BURNT LIME

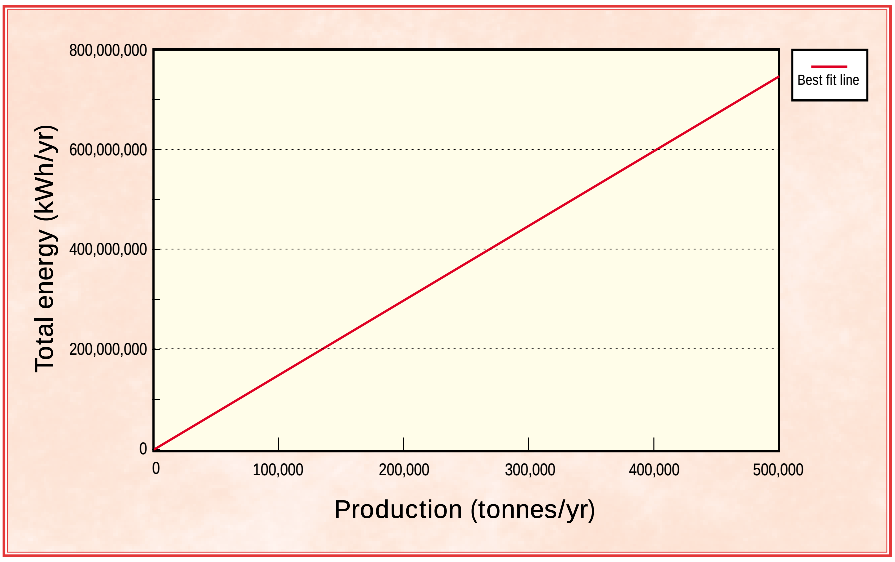
Burnt lime is produced by firing limestone in natural-gas-fired kilns. The main end uses are in the steel industry and chemical processes. Because of the highly competitive nature of the industry, data are difficult to obtain, so these results represent an important compilation. Data were provided for five of the nine sites in the sector. To preserve confidentiality, no points are shown on the graph and a bar chart is not presented.

Total sector production is estimated at 2.5 million tonnes with a total sector energy bill of £19.2 million.

As is clear from Table 1 (page 3), lime burning is a high energy use operation, with most of the energy being provided by natural gas. It is natural to suppose that energy efficiency would be an imperative in such a high energy sector. This is supported by the statements made by operators and confirmed by the SECs for sites, which are very similar, regardless of size, and which all fall very close to the best fit line on the SEC graph (Fig 19). However, this does not mean that there are no opportunities for improvement.

The effects of electricity prices are dramatically illustrated in Fig 20 which shows that a use of 2% electricity corresponds to a cost proportion of 22%. British Sugar is an additional lime burner with 11 kilns producing a substantial tonnage of lime used for processing 10 million tonnes of sugar beet, mainly in the autumn and winter of each year. The company provided an average figure for its coke-fired kilns which, interestingly, gave a very similar SEC to the others. It was not used in the calculation of the weighted average of the SECs quoted in Table 1.

Fig 19 Annual energy consumption in the burnt lime sector



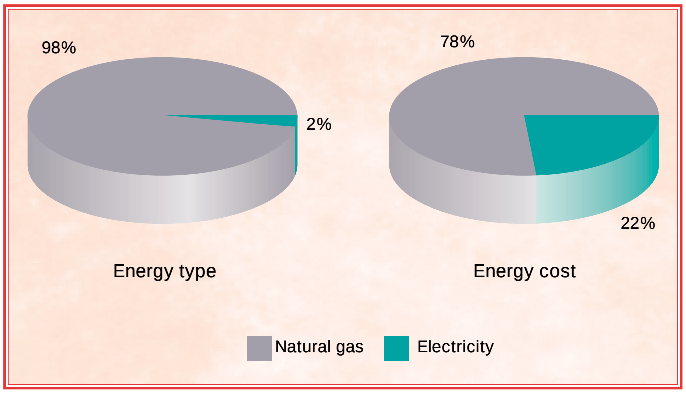


Fig 20 Energy use and cost in the burnt lime sector

BITUMINOUS PRODUCTS

BITUMINOUS PRODUCTS

In 1995, 34.9 million tonnes of bituminous products were produced by 326 operations, ranging in size from 15,000 - 650,000 tonnes. There were 95 respondents to the survey.

The delivered energy use for the whole sector for the period was estimated to be 3.8 million MWh, costing in the order of £60 million.

Bituminous products (asphalts and coated macadams comprising mixes of aggregates and bitumen binder) are produced in plants in which the aggregates are dried and heated in rotating drums and preheated bitumen is then added, either in the drum (drum mixing), or in a separate mixing unit. The bitumen is stored in heated storage tanks prior to use.

There are two main types of plant: continuous mixers which are usually large and may be rated up to 450 tonnes/hour, and batch mixers which are more flexible and versatile but tend to be smaller. About 50% of operators identified the type of unit they used, but the energy use data does not show either of the two types as clearly more efficient.

Fig 21 illustrates the spread of data about the mean and Figs 22 and 23 show how energy use varies with production levels. Although the scatter of points around the best fit line is not as wide as in some of the other sectors, some efficient plants use only half as much energy as other less efficient plants of similar size. At a production level of 120,000 tonnes/year, this equates to a cost saving of £135,000/year for the efficient sites.

The rotating drums are electrically powered while the drying and heating of the stone is usually fuelled by gas oil and reclaimed oil in proportions which vary on individual sites. Six respondents used natural gas for the latter processes.

Fig 24 shows the split between energy types and costs for three types of plant: those using gas oil, those using reclaimed oil, and those using natural gas.

Two general conclusions can be drawn, based on the fact that electricity is expensive and reclaimed oil is cheaper than gas oil. Firstly, if you use natural gas, concentrate on reducing your electricity use. Secondly, if you use fuel oil, investigate the opportunities for using as large a proportion of reclaimed oil as possible.

Table 1 (page 3) shows that the sector is a high energy user and, consequently, any percentage reduction that can be achieved will result in large cost savings.

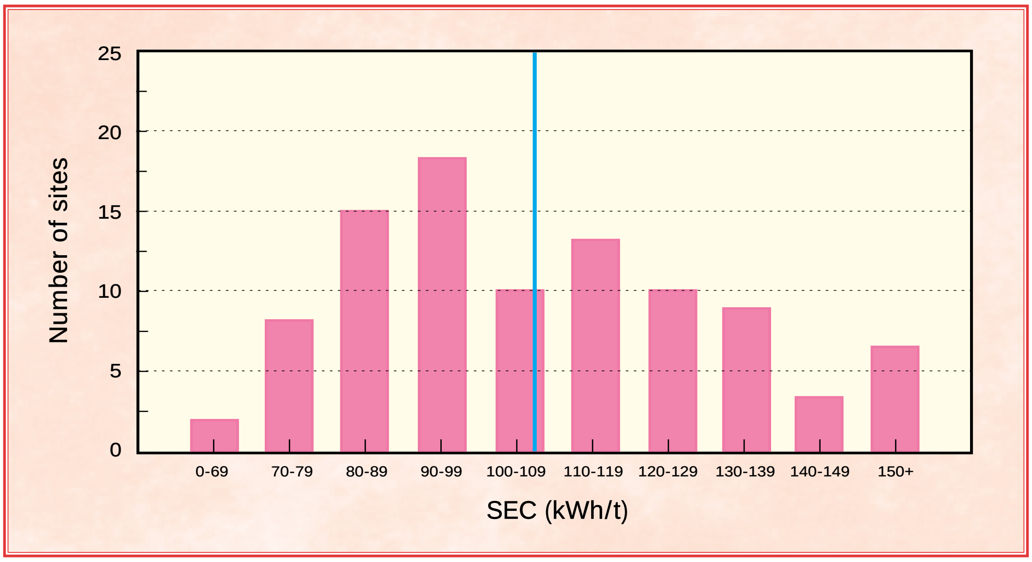


Fig 21 Range of SECs in the bituminous products sector

BITUMINOUS PRODUCTS

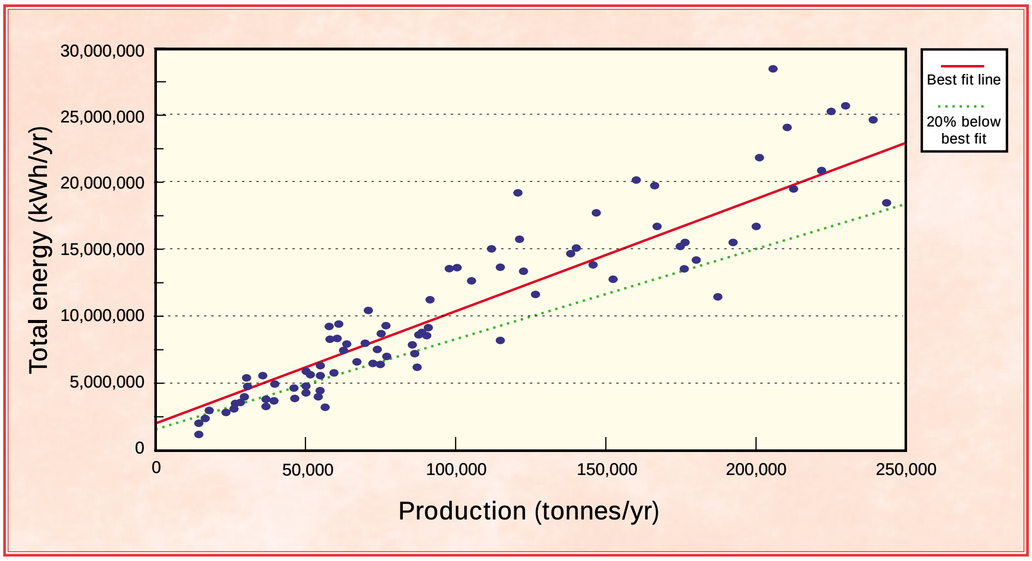


Fig 22 Annual energy consumption in the bituminous products sector (site production 0 - 250,000 tonnes)

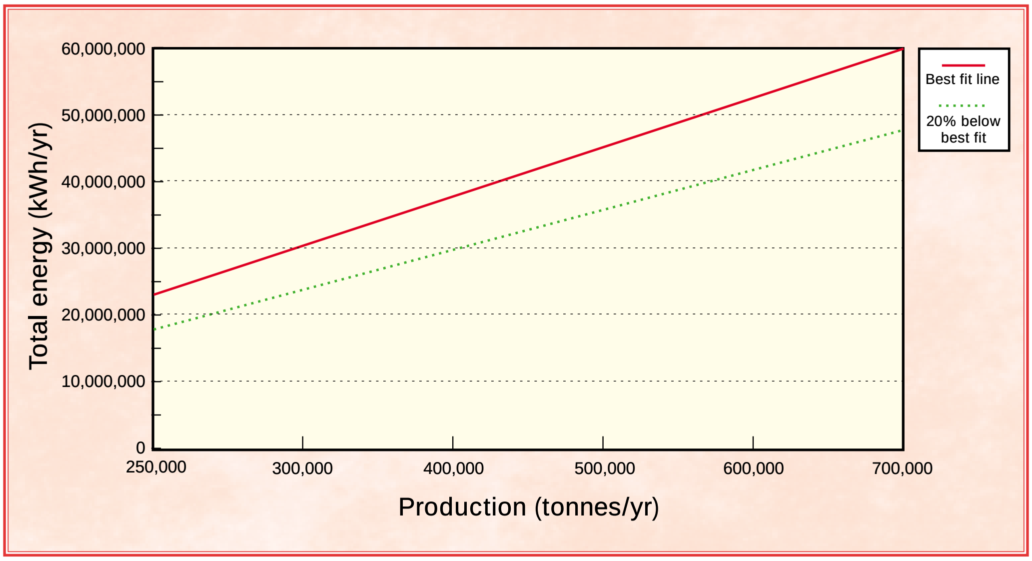


Fig 23 Annual energy consumption in the bituminous products sector (site production 250,000 - 700,000 tonnes)

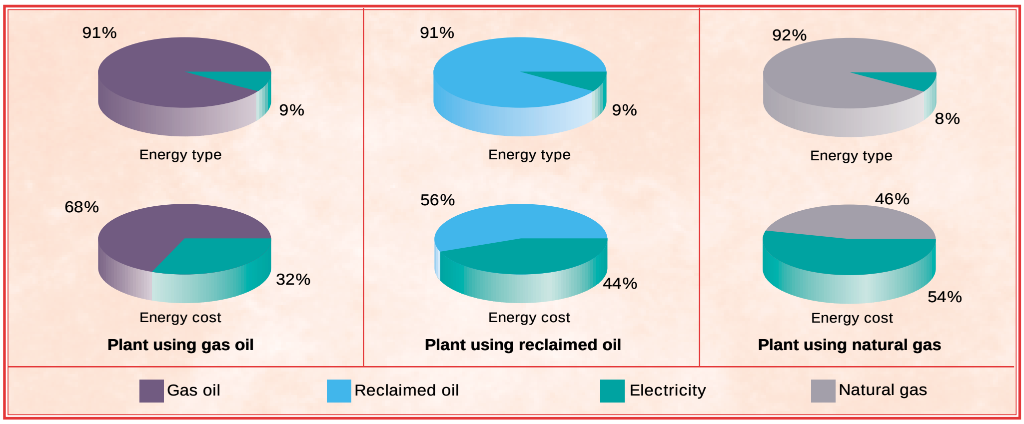


Fig 24 Energy use and cost in the bituminous products sector

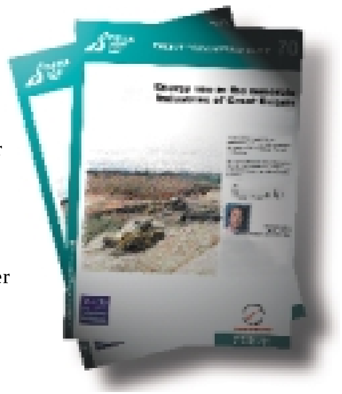
THE ENERGY USE CALCULATOR

WHERE DO YOU START?

Energy costs are easy to control, but first you need to know:

- how much you use;
- how you use it;
- how much it costs.

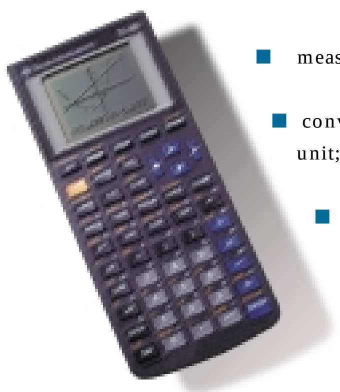
You can then adopt practices to improve your energy efficiency, starting in the areas which offer the greatest potential for savings.



CALCULATING ENERGY USE

To begin to control your organisation’s energy expenditure, you must have a clear idea of how much energy is being used to carry out the basic activities of your business. A simple procedure for calculating energy consumption is outlined below:

- measure how much electricity and oil you use;
- convert these amounts to a standard energy unit;
- calculate your total energy use;
- compare your energy consumption with data shown in the Figs for your sector.



MEASURING ENERGY USED

The main energy sources used in the minerals industries are electricity, fuel oil, reclaimed oil, and natural gas. To calculate energy consumption, readings must be taken from the electricity meters, gas meters and fuel oil gauges.

It is best to calculate energy use over at least one full working week, taking readings on, for example, consecutive Mondays. Production should be recorded during the same period.

CONVERTING ENERGY USED TO KWH

To find your total energy use, and to enable comparisons, all the energy consumption totals need to be in the same energy unit.

Energy consumption tends to be quoted in kilowatt-hours (kWh). Electricity is already in kWh, but other fuels should be converted as follows:

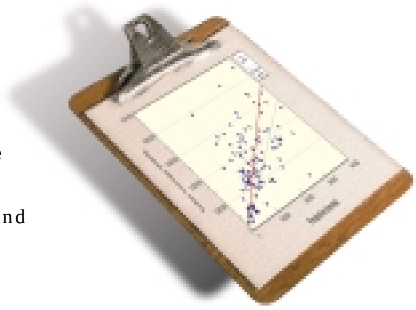
- gas oil (35 sec), measured in litres, should be multiplied by 10.6 to give the kWh equivalent;
- reclaimed oil, measured in litres, should be multiplied by 10.8 to give the kWh equivalent;
- natural gas, measured in therms, should be multiplied by 29.3 to give the kWh equivalent.

THE ENERGY USE CALCULATOR

CALCULATING TOTAL ENERGY USE

Adding together the kWh for each energy source gives the total energy use for your organisation. This figure, divided by the tonnes of product produced during the week, gives the SEC or kWh/tonne. This figure will enable you to compare your energy performance with that of others in your sector.

The energy use calculator form below provides an easy-to-use layout for recording the energy measurements and calculating total energy used and kWh/tonne.



ENERGY USE CALCULATOR

	Week start	Week finish	Difference	Multiply by	Energy used (kWh/week)
Electricity meter reading (kWh)					
Oil tank gauge readings:					
Gas oil (35 sec)				10.6	
Reclaimed oil				10.8	
Natural gas				29.3	
Total energy used					
Amount of material produced per week					tonnes/week
Energy/unit of material produced, i.e. SEC ❶					kWh/tonne
Comparison with industry average					
Your actual energy use/unit of material produced (i.e. SEC ❶ from above)					kWh/tonne
Annual production ❷					tonne
Annual energy use ❸ (❶ x ❷)					kWh
Industry average energy use (read from appropriate line graph for your sector and your level of production)					kWh
Difference ❸ - ❹					kWh
If your results are higher than the industry mean, you could be wasting energy and money. Even if your results are lower, you can still set targets and try to do even better.					

ACTION PLAN

THE ENERGY EFFICIENT ACTION PLAN

Here is a five-point plan to save energy immediately – without incurring much cost.

- **Measure and monitor**
  If you can't measure it, you can't save it - because you have no way of knowing how your operation is performing. If you do not have the data, the first stage of energy management for your company should be to establish a monitoring system as part of the day-to-day operation.

- **Calculate your SEC**
  Complete the energy use calculator using your data. Compare your figure with the sector mean and see where your operation plots on the relevant graph (Figs 2, 3, 5, 6, 8, 13, 14, 17, 19, 22 and 23).

- **Set your target**
  The first targets you should set yourself are the best fit lines for your sector. If your energy use is already near this value, then set yourself a lower target. For example, the graphs of energy against production show a target line which is 20% lower than the best fit line. If you are already better than this, why not set an even more challenging target?

- **Involve your staff**
  Put someone in charge of energy management and provide him/her with the appropriate support.

  Train your staff in the importance of energy conservation and good management. Win commitment and maintain interest by publishing and disseminating internally the results of good practice by way of wall charts, newsletters and bulletin sheets.

- **Keep going**
  Review the results of your energy saving campaign and then set further targets and plan new initiatives.

It costs virtually nothing to set up an initial system, but once targets are set and energy use is being addressed you will need to consider low-cost options to maintain momentum. Modifying or varying equipment does cost money but the savings in energy costs ensure repayment in a comparatively short time.

STEPS TO ENERGY EFFICIENCY

Some measures which you may wish to consider are given below. Further information is available from the Energy Efficiency Best Practice Programme (see back page for contact information).

- Improve metering systems for effective monitoring.
- Ensure that the capacity of equipment - especially motors and pumps - is appropriate for the production process.
- Consider installing higher efficiency motors and other equipment using soft starts where appropriate.
- Consider installing variable speed drives on motors which satisfy varying demands.
- Lag bitumen drums.
- Install time clocks on heater/cooler systems.
- Install energy efficient lighting and heat/movement-sensitive external security systems instead of overnight floodlights.
- Initiate planned, preventive maintenance programmes on all equipment.

Other low-cost measures include: maintaining good haulage surfaces; re-using wastewater; improving blasting efficiency to reduce downstream crushing requirements; improving work scheduling to run equipment in blocks and shut it down completely at idle times.

All these measures are low cost but the payback can be substantial.

Energy use is a variable cost you can attack. Savings go straight onto the bottom line, so make sure you act today.

INDUSTRY EXAMPLES

AGGREGATE INDUSTRIES

Since 1995 Camas Aggregates (now Aggregate Industries) has been running a monitoring scheme for the company's quarry and bituminous product operations.

Every manager completes a monthly calculation, like the one on page 17, and targets are set for each site. Site and plant management then have the responsibility of at least maintaining their site's performance; preferably they will take action to reduce site energy use. The whole scheme is co-ordinated at regional level.

The setting of targets is important because it means that every site can work towards an objective. There is no room for complacency and even those with consumption below the initial target figure are still encouraged to reduce energy use.

It is estimated that the company has reduced its total energy bill by about 15% in less than two years.

The whole process cost very little to set up, the most important requirement being the education of the managers in the importance of energy saving, raising the awareness of the workforce, and ensuring their commitment to the programme.

REDLAND AGGREGATES

Redland Aggregates' Mountsorrel Quarry is a large granite quarry in Leicestershire. It has a very high energy bill but the energy is used very efficiently. Even accounting for economies of scale, consumption is well below the industry mean in all sectors. This is because systems have been put in place to monitor energy consumption and act upon the results.

The company's extensive electricity metering enables management to measure and analyse consumption and identify high energy use equipment within fixed plant. Fuel oil use in mobile plant and in the coating plants is also monitored. When high use operations are identified, action is taken to reduce the energy consumption. This is supported by a policy of replacing fixed and mobile plant with the most energy efficient equipment, when it needs to be renewed. Full lifetime costs are considered, including the purchase price and the expected running costs.

Each member of the management team has been trained to appreciate the cost savings that energy efficiency can produce, and is expected to take the actions that will be the most effective within their part of the operation.

HEPWORTH MINERALS AND CHEMICALS

Hepworth Minerals and Chemicals (HMC) has completed several projects at the company's Dingle Bank Quarry to replace oversized pumps with smaller submersible pumps and fit variable speed drives to pumps which satisfy a varying demand.

The total cost of the project to HMC was £26,300 resulting in savings of £12,200/year.

The reduced maintenance cost of the submersible pumps gave a further saving of £3,500/year. In addition, and just as important for HMC, is the improved product consistency which resulted from the more precise delivery of water to the wash plants.

Details are given in Good Practice Case Study 358 (see back page).

ARC

In 1990 a new roadstone plant was installed at ARC Northern's Criggion Quarry. At the same time the opportunity was taken to install sufficient metering so that the site's electricity consumption could be measured at half-hourly intervals.

The energy demand profile obtained indicated a high night load during unproductive periods. This was originally attributed to space heating but detailed study showed that the main contributor was the trace heating system at the new bitumen plant.

The installation of time switches and an electrical maximum demand system, together with the training of operators in energy management techniques, resulted in a decrease in energy consumption of over 20%/tonne.

The project cost £1,400 to implement and saved energy worth £14,000/year.

Details are given in Good Practice Case Study 354 (see back page).

FURTHER INFORMATION

There are a number of publications available free from the Energy Efficiency Best Practice Programme which will help you implement some of the energy efficiency techniques described in this Guide. Please contact the Energy Efficiency Enquiries Bureau, ETSU, Harwell, Didcot, Oxfordshire, OX11 0RA. Tel 01235 436747, Fax 01235 433066, E-mail etsuenq@aeat.co.uk

Energy Consumption Guide 47, *The minerals industries of Northern Ireland*
Gives details of energy consumption in the quarrying and bituminous products industries in Northern Ireland. Energy use is broken down by process, by fuel and by site production level.

Good Practice Case Study 358, *Installation of variable speed drives and small submersible pumps*
As described on page 19 of this Guide.

Good Practice Case Study 354, *Energy monitoring and management system*
As described on Page 19 of this Guide.

Good Practice Case Study 222, *Purchasing policy for higher efficiency motors*
Describes how ECC International adopted a policy of installing higher efficiency motors on operational plant. Savings of £12,000/year were achieved with a payback of 1.3 years.

Good Practice Case Study 216, *Toroidal fluidised bed reactor for mineral processing*
In this Case Study, five rotary furnaces used for the exfoliation of vermiculite ore were replaced with a toroidal fluidised bed reactor. Total savings of £100,000/year were achieved with a 16-month payback.

Good Practice Case Study 163, *A co-ordinated approach to energy management*
Describes how Cleveland Potash Ltd saved £375,000/year when it appointed an energy manager and introduced a monitoring and targeting system.

Good Practice Guide 181, *Energy efficient crushing and grinding systems*
Provides guidance for the efficient operation of comminution machinery, explaining how substantial energy savings can be made by improving existing plant or by using new technologies. Includes a number of case examples.

Good Practice Guide 126, *Compressing air costs*
Compressed air is an expensive source of energy, equating to 50 p/kWh, and it is estimated that over 30% is wasted. GPG 126 describes how to identify and implement savings.

Good Practice Guide 84, *Managing and motivating staff to save energy*
Describes techniques to gain the enthusiasm of staff in identifying and developing energy saving ideas and projects.

Good Practice Guide 2, *Energy savings with motors and drives*
Provides comprehensive guidance on: higher efficiency motors; variable speed drives; soft starts; the cost implications of motor replacement versus rewinding; various other techniques.

New Practice Final Profile 51, *Using exhaust gases from gas turbine CHP for direct product drying*
This project at ECC International (ECCI) involved the introduction of a gas turbine CHP system to generate electricity and dry china clay. The installation was organised by a contract energy management company and savings to ECCI amounted to £160,000/year with no initial investment.

General Information Report 49, *Energy minimisation in road construction and maintenance*
Describes the energy saving potential when using a variety of alternative road construction materials and techniques including: industrial by-products as aggregates; self-cementing materials; cold-bitumen emulsion-bound materials; subgrade stabilisation; and *in-situ* recycling. Publication **GD97001** summarises the key findings in the GIR and is easily understood by non-experts.

THE ENERGY HELPLINE
The Energy Helpline offers free advice to small and medium-sized companies with specific energy efficiency queries or problems. Call the Energy Helpline on 0541 542541.

The Department of the Environment, Transport and the Regions' Energy Efficiency Best Practice Programme provides impartial, authoritative information on energy efficiency techniques and technologies in industry, transport and buildings. The information is disseminated through publications, videos and software, together with seminars, workshops and other events. Publications within the Best Practice Programme are shown opposite.

Further information

For buildings-related topics please contact:
Enquiries Bureau
BRECSU
Building Research Establishment
Garston, Watford, WD2 7JR
Tel 01923 664258
Fax 01923 664787
E-mail brecsuenq@bre.co.uk

For industrial and transport topics please contact:
Energy Efficiency Enquiries Bureau
ETSU
Harwell, Didcot, Oxfordshire,
OX11 0RA
Tel 01235 436747
Fax 01235 433066
E-mail etsuenq@aeat.co.uk

Energy Consumption Guides: compare energy use in specific processes, operations, plant and building types.

Good Practice: promotes proven energy efficient techniques through Guides and Case Studies.

New Practice: monitors first commercial applications of new energy efficiency measures.

Future Practice: reports on joint R & D ventures into new energy efficiency measures.

General Information: describes concepts and approaches yet to be fully established as good practice.

Fuel Efficiency Booklets: give detailed information on specific technologies and techniques.

Energy Efficiency in Buildings: helps new energy managers understand the use and costs of heating, lighting etc.